

DIMENSIONS

NBS



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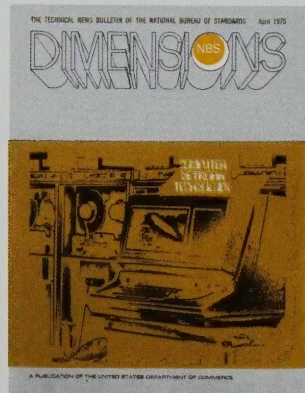
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Cover: Computer networks affect almost everyone's life. Networks are used to increase services in such areas as education, health, transportation and trade. For a look at how they work and NBS' activities in this area, see "Computer Networks Are Here" on page 75.

U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary

Betsy Ancker-Johnson
Assistant Secretary
for Science and Technology

NATIONAL BUREAU OF STANDARDS
Richard W. Roberts, Director

Prepared by the NBS Office of
Information Activities
Washington, D.C. 20234
William E. Small, Chief

Richard S. Franzen,
Chief, Editorial Section

Sharon A. Washburn,
Managing Editor

Contributing Editors
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The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

The Institute for Basic Standards
The Institute for Materials Research
The Institute for Applied Technology
The Institute for Computer Sciences and Technology

Center for Radiation Research
Center for Building Technology
Center for Consumer Product Safety

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COMPUTER NETWORKS ARE HERE

by Shirley W. Watkins and
Ira W. Cotton*

COMPUTER network technology, in its infancy just a decade ago, now impacts many sectors of our society. Uses range from scientific and technical applications to service functions in education, health care, transportation, banking and retailing.

Within the Federal Government, the advantages of computer networking are being recognized by many agencies. Through its activities in the Institute for Computer Sciences and Technology (ICST), the National Bureau of Standards serves as a focal

point for Federal interest in networking. NBS' networking activities center on the efficient and effective use of networks in the Federal sector. At the same time, NBS seeks to assure that the confidentiality of data is maintained and that the privacy rights of individuals are respected.

Sharing Resources

The growth of networks was stimulated by the need for effective methods to permit sharing of expensive, computer-based resources such as special hardware, special software (computer programs) and large data bases. Networks can provide needed computer resources to those who lack their own or who need backup or additional capacity. Networks can also

facilitate the use of computer-based services by broader segments of our society. Reservation systems, for example, build on a technological capability to provide a service, and use a network for the delivery of that service.

A computer network is the result of any interconnection of computer systems and terminals through communications facilities. A network can be as simple as a single computer made accessible to a number of remote terminals through the dial telephone system. Or, a network can be as complex as a national or international complex of individual computers interconnected through dedicated, high speed communications lines.

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*Mrs. Watkins, a mathematician, and Mr. Cotton, a computer specialist, are both members of NBS' Computer Systems Engineering Division.

NETWORKS *continued*

How They Developed

A number of different technological developments had to mature to permit networking as we know it today. Of primary importance was the development of timesharing in the mid-1960's which permitted the simultaneous use of computers by many individual users. Since then, there has also been a dramatic increase in the size and cost of some computers (maxicomputers) and an equally dramatic decrease in size and cost of others (minicomputers). Interestingly, the need to make expensive maxicomputers affordable by sharing their costs among multiple users is satisfied by using the inexpensive minis in communication systems.

Traditional communications technologies such as the voice telephone network have been revolutionized by electronic switching systems, which are computer based. New network technologies such as packet switching have become economically feasible because of the message handling capabilities of minicomputers.

Another technological development contributing to the growth of networks was the development and mass production of specialized terminals suitable for many different specific applications. Stock brokers now have their own type of terminal as do airlines, banks, retail stores and other industry groups. Terminals have improved in capability, decreased in cost and have been well received by users because they are tailored to the particular application at hand.

Services Increased

Computer networks play important roles in providing needed services to citizens. In education, for example, networks facilitate equal opportunity for all students. In North Carolina, an educational network is providing the same computer resources to 11 smaller universities, 14 liberal arts colleges, 22 community arts colleges and 10 high schools as are provided to the three largest universities in the state.

Networks are also having significant impact in furnishing adequate medical care to citizens. Networking of the extensive recordkeeping activities in major hospitals makes possible the maintenance of a constantly updated composite patient record which unifies the patient's medical history, test results, therapy experiences and drug intake.

Computer networks are also being used in the intensive care units of hospitals. In automated coronary care units, a dedicated microcomputer preprocesses electrocardiographic data from the patient and relays this to a central minicomputer, which performs high level data analysis and automatically triggers an alarm to summon help if the signs exceed defined limits.

The National Library of Medicine's MEDLINE bibliographic system provides still another example of the use of networks in the medical field. This system provides on-line bibliographic information on the latest medical developments to users across the continental United States, Hawaii and England.

In the service sector, the use of networks in reservation systems is familiar to most travelers. As a result

of networks, we have come to expect instantaneous, complete and reliable information when we reserve a hotel room, a rental automobile or an airline seat. Even theater tickets are now sold through network systems, with special terminals capable of printing and issuing the ticket at the time the transaction is made.

The retail industry has found the information handling capabilities of computer networking a tremendous advantage. Conventional cash registers are being replaced with networks of point-of-sale (POS) terminals. These terminals transmit such information to the computer as the customer's account number and transaction amount, and the computer supplies credit verification in return. POS terminals also enable continuous management control of inventory levels to prevent shortages and to respond rapidly to changes in local consumer preferences. About 200,000

The grocery industry is beginning to use point-of-sale terminals to reduce operating costs and to maintain continuous management control of inventory levels.



POS terminals are already installed in general merchandise stores across the Nation. Encouraged by this successful application of networking in the retail environment, the grocery industry is working toward a system of POS terminals and automatic checkout counters to help reduce costs. It is expected that 100,000 grocery terminals will be functioning by 1980.

NBS Role

The number of computer systems connected as a part of networks has increased rapidly. Within the United States as a whole, more than 20 percent of all computers are now networked. In the Federal Government—traditionally a leader in the use of this technology—more than 50 percent by dollar value of its \$4 billion computer inventory (2,300 systems) are now connected in networks.

At NBS, ICST's networking program is directed toward reducing the cost to Federal agencies of using computers by offering them network-based sharing and better matching networking requirements with available networks and services. ICST is, at the same time, working to ensure the personal privacy and confidentiality of information maintained in networking systems.

Its program involves the preparation of Federal networking guidelines, as well as the development of new tools and standards for Federal agency use. NBS also contributes special assistance to agencies with urgent networking problems. For example, the Institute is helping the National Weather Service plan a computer network for the collection, processing and distribution of weather data, including forecasts and disaster warnings. Speed, accuracy, reliability



The Network Measurement Machine, operated here by Shirley Watkins, collects data on the adequacy of network service rendered to users.

and cost are prime concerns of the network. ICST is providing assistance in selecting the network configuration to be implemented.

NBS guidelines and standards in the networking area are based on actual "hands-on" experience with current networks, as well as on the development of new tools and techniques for the evaluation and use of networks. For example, NBS operates a Terminal Interface Message Processor (TIP), the communications interface to the nationwide, experimental ARPA network, for the use of NBS staff and more than 20 other agencies in the Washington, D.C. area.

One of the first things ICST learned from operating the facility was the need to be able to measure the level of service provided to each user by the network. As a result of this concern for the measurement of network service, NBS developed the Network

Measurement Machine, which approaches the measurement and evaluation of computer networks and network services from a new perspective. Instead of focusing on the internal operations of the network, this system focuses on the service rendered to the individual users. This machine collects data on the responsiveness of a network to individual user requests for service. This data is then analyzed to assess the network's ability to provide such service.

A second new tool developed by NBS is the Network Access Machine, a minicomputer-based system which helps people utilize network services. Network users often find the procedures they must follow to use computer networks both confusing and cumbersome. The Network Access Machine relieves this problem by executing complex network procedures in response to simple user

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A photograph of a metal test fixture, possibly a calorimeter, featuring a vertical stack of rectangular blocks. The fixture is positioned on the left side of the frame. Behind it, a series of concentric circles are drawn on a light background, creating a ripple effect that suggests heat or air flow emanating from the fixture. The text is located on the right side of the image.

there's more
to comfort
than
HOT AIR

DURING the winter, when you feel cold indoors, you probably put on a sweater, turn up the thermostat or do both. But do you ever think of what's really making you cold?

If you're sitting, sleeping or working near an outside wall, the problem may not be air temperature. Since the human body exchanges radiant energy with surfaces close by, you could be "losing" heat to that cold wall. Even with warm air temperature inside, you still feel cold near the wall.

In order to incorporate accurate wall temperature measurements in thermal comfort studies, the National Bureau of Standards has developed a new instrument, the scanning radiometer. The new scanning radiometer increases understanding of the indoor environment by providing a 360-degree profile of "radiant environment" in a room. Currently it is being used to help determine how much energy a homeowner could save by adding wall insulation and other energy-conserving features to his house.

Dr. Theodore H. Benzinger designed, built and calibrated the new instrument at NBS with the aid of Dr. Billy W. Mangum and Dr. James E. Hill. According to Hill, the scanning radiometer "measures the effective surface temperature of those things that 'view' the human." Unlike previous instruments, it can measure the average value of these quantities over the hemisphere that the human faces. The 360-degree profile is obtained by rotating the instrument a full-turn.

What Determines Comfort?

While air temperature is often

considered the most important factor in determining indoor comfort, there are other variables that govern the feeling of comfort. In addition to air temperature, the relative humidity, air velocity, mean radiant temperature (MRT), level of activity and amount of clothing worn all affect thermal comfort.

For a person inside a room, MRT refers to an effective radiant temperature of the wall surfaces surrounding him. Many walls, especially uninsulated ones, easily transfer energy to the outside air. These walls feel cold because they have a lower inside surface temperature.

One of the conventional instruments used to measure MRT is the globe thermometer, a spherical instrument hung from the ceiling in the middle of a room. "The globe thermometer exchanges energy by radiation with everything around it and arrives at an equilibrium temperature which can be used to determine the effective radiant temperature of all the walls," explained Hill.

However, the globe thermometer cannot tell if one wall is 20 degrees colder than another wall, or identify the direction of the cold surfaces; it cannot determine the degree of asymmetry of the radiation. The scanning radiometer can.

The Scanning Radiometer and Energy Conservation

Mounted on a tripod with a "head" that turns 360 degrees, the scanning radiometer can measure the effective radiant temperature in any direction. Unlike the globe thermometer, which measures an average temperature of all the room surfaces, the scanning radiometer can be pointed in one direction to measure

the radiant temperature of, for example, one wall which has an outside window.

The new instrument will be used in studies in the NBS townhouse, a complete house equipped with a solar heating and cooling system for research purposes. "In the townhouse we'll be studying energy savings in a house with non-conventional equipment, and the scanning radiometer will help us determine the comfort level inside the house," said Hill. "We'll be making directional measurements of radiant temperature which we couldn't make before with the globe thermometer."

In its present application, the scanning radiometer is set up in one room of the Bowman House, a 20-year-old wood-frame house on the ground of the NBS campus in Gaithersburg, Md. Researchers from the NBS Center for Building Technology are measuring the amount of energy used in winter heating and summer cooling before and after energy-conserving features are added to the house. They completed the 'before' energy measurements during winter and summer of 1974. Storm windows, weather stripping, insulation and other features have now been added, and the 'after' energy measurements are under way.

Although the Bowman House study is not yet completed, NBS researchers expect the scanning radiometer to show that insulated walls result in a higher radiant temperature. By preventing exchange of energy between the outside and the inside, insulated walls make a room feel warmer. People in an insulated house can turn down the thermostat a small amount and still feel comfortable. By doing so, they reduce fuel costs and save energy. □

Laser-Induced Photochemical Enrichment of Isotopes

High-Yield Photochemical Separation of Boron and Chlorine Isotopes Achieved in NBS Experiments

TWO teams of scientists at the National Bureau of Standards have successfully used photochemical techniques for concentrating isotopes of chlorine and boron.

Their success increases the likelihood that similar methods will be found for other isotopes, especially those that (like the chlorine and boron isotopes) can be used in medical research.

In both the chlorine and boron experiments, radiation from a laser was tuned to excite molecules containing just one or the other of two isotopes, thereby greatly accelerating chemical reactions between the excited compound and other substances in the test cell. And in both experiments, significant quantities (milligrams) of stable compounds substantially enriched in either of the isotopes were obtained.

A single irradiation lasting several hours changed the concentration of chlorine-35 in the initial gas mixture from 75 percent to either 64 or 80 percent, depending on whether—by suitable choice of the excitation wavelength—it was the molecules containing chlorine-35 that were excited or those containing chlorine-37.

Similarly in the boron experiment, by exciting compounds containing either the boron-10 or boron-11 isotopes, the original 20-percent concentration of boron-10 decreased to 14 percent or rose to 29 percent.

Participating in both investigations were scientists at the NBS Institute for Basic Standards (IBS) and the NBS Institute for Materials Research (IMR), in a program coordinated by Dr. Richard D. Deslattes of IBS. Collaborators in the chlorine experiment were Dr. Michel Lamotte, NATO Fellow at IBS (on leave from the Faculty of Sciences of Bordeaux, France); Dr. Harry J. Dewey, NBS/NRC Postdoctoral Fellow at IBS; Dr. Richard A. Keller, IMR; and Dr. Joseph J. Ritter, IMR. The boron experiment was performed by Dr. Samuel M. Freund, IBS, and Ritter.

Underlying Principles

Two main phenomena underlie the possibility of photochemical enrichment techniques. First, there is the fact that the wavelengths of spectral lines emitted, and absorbed, by a molecule depend somewhat on the isotopes present in the molecule. Second, the rate of a chemical reaction is sometimes influenced by the state of excitation of the participating molecules. Although the precise mechanisms of the latter process are not very well understood, educated guesses can occasionally be made as to which excitations are likely to accelerate a given reaction.

In selecting starting materials for the present experiments, therefore, a number of conditions had to be satisfied:

(1) In one of the compounds, the effect of isotopic content on the wavelengths of one or more of its spectral lines must be large enough for there to be some chance of finding a monochromatic source (probably a laser) whose radiation could excite (that is, be absorbed by) one type of isotope-containing molecule without exciting the others.

(2) A laser is needed whose radiation happens to match in wavelength one of the isotope-dependent lines, or a laser that can be tuned to such a wavelength. And the spectral width of the laser radiation must be narrow enough to excite molecules containing one of the isotopes and not the others.

(3) The isotope-containing compound must be mixed with other substances with which it is known to react fairly slowly, but which can be made to react more rapidly when the isotope-containing compound is excited by the radiation chosen.

(4) Transfer of excitation from one molecule to another by collision, and "scrambling" of isotopes through collisions of reaction products with other reactive species (for example, free radicals) present, must be negligible, since both of these factors tend to reduce the selectivity of the overall process.

Isotopes for Medical Research

Various methods of selectively exciting particular isotopes or isotope-containing molecules and then separating them by physical or chemical processes are being intensively explored in a number of laboratories. Some of these efforts relate to the separation of uranium isotopes for nuclear fuels, in the hope of achieving a method more economical than the

very expensive ones currently used.

Pure or enriched isotopes and isotopic compounds are also much needed as tracer materials for medical research and diagnosis and biological research. It is in these areas, primarily relating to the lighter elements, that the immediate significance of the NBS experiments is believed to lie. It is hoped that further experiments will clarify the mechanisms by which excitation of molecules or atoms influences chemical reactivity, so that generalizations to other systems (possibly even to uranium) can be made.

Features of the Experiment

Among the attempts made thus far to promote chemical reactions involving compounds containing particular isotopes, the NBS experiments appear to be the first to achieve appreciable yields. Additionally, each employs only one (laser) source of excitation.

The milligram quantities of enriched isotopic materials obtained are

at least 10 times greater than those in previously reported results. No attempt was made to maximize yields, and only about 5 percent of the laser radiation was used in either experiment. By carefully redesigning the experiments, the scientists believe, much greater yields can be expected.

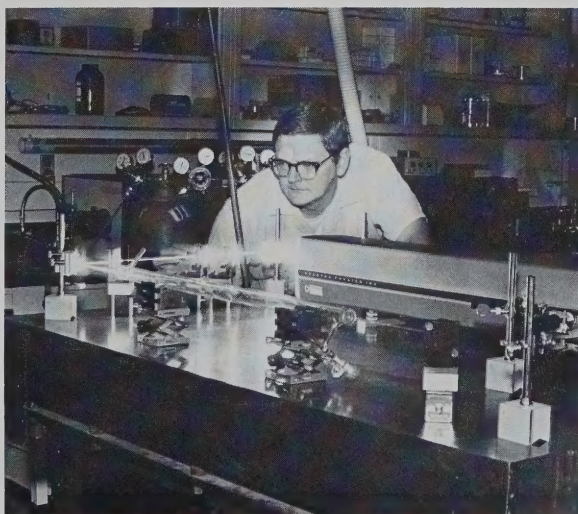
Both the chlorine and the boron processes lend themselves to recycling. That is, the products or the residual (unreacted) gas can be used as starting materials for a repetition of the process. By using several such cumulative stages, each of which increases the relative abundance of one of the isotopes, higher concentrations could be attained.

Boron Experiment

In the boron experiment, infrared radiation from a carbon dioxide TEA laser stimulates a chemical reaction between gaseous boron trichloride (BCl_3) and hydrogen sulfide (H_2S).

The BCl_3 , at a pressure of 270 pascals (2 torr), and H_2S at various pressures

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Dr. Richard Keller inspects set up used to excite molecules containing isotopes of chlorine.

sures up to 1300 pascals (10 torr) were admitted to an approximately spherical cell of 10-centimeter (4-inch) diameter. The laser beam was focussed at the center of the cell to minimize wall reactions, which could undo the effects of the radiation.

The laser was operated at 10 pulses per second, each pulse lasting 300 nanoseconds and carrying about 0.1 joule of energy. No isotopic enrichment was obtained when the pulse duration was increased to one microsecond, even with the same peak power, the reasons for which are now under investigation.

Products of the reaction are principally involatile white solids and hydrogen chloride. Enriched boron is recovered as BCl_3 when the solid products are treated with elemental chlorine, or as unreacted BCl_3 .

To study the processes taking place

inside the cell, infrared spectrophotometry and mass spectrometry were applied to the substances that condensed in three cryogenic traps maintained at -63°C , -130°C and -196°C , respectively.

Two different wavelengths of the CO_2 laser were employed. Radiation at $10.55\text{ }\mu\text{m}$ was used to excite the $^{11}\text{B-Cl}$ stretching vibration in the BCl_3 starting material. After irradiation for periods up to 10 hours, the natural 80.5-percent abundance of boron-11 in the residual gas fell to 70.8 percent. The boron-10 concentration correspondingly increased from 19.5 to 29.2 percent.

The $^{10}\text{B-Cl}$ stretching vibration was excited by radiation at $10.18\text{ }\mu\text{m}$ wavelength. After about 5 hours of irradiation, the boron-10 concentration went from the natural 19.5 percent to 14.5 percent, with corresponding enrichment of the boron-11.

Chlorine Enrichment

Two different lasers were used for selective excitation of molecules of chlorine-containing thiophosgene (CSCl_2): a tunable dye laser to excite the molecule containing chlorine-35 ($\text{CS}^{35}\text{Cl}_2$) and an argon (Ar^+) continuous-wave laser to excite thiophosgene containing chlorine-37 ($\text{CS}^{37}\text{Cl}_2$).

The excited thiophosgene molecules were reacted with diethoxyethylene (DEE) in a cylindrical test cell 2 centimeters (0.8 inch) in diameter and 80 centimeters (32 inches) long. The laser beam was directed along the 80-centimeter (32-inch) axis. In the final runs, the starting mixture consisted of gaseous CSCl_2 at a pressure of 67 pascals (0.5 torr) and gaseous DEE at 200 pascals (1.5 torr).

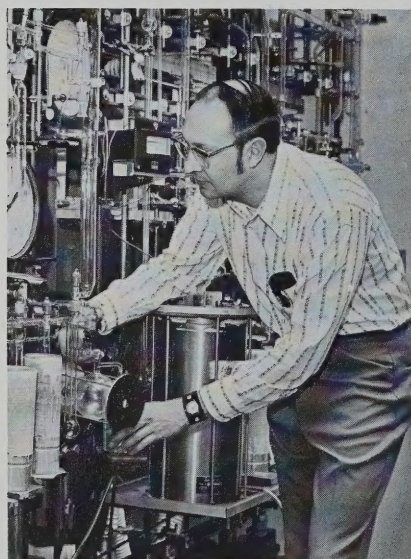
Reaction products appeared first as a fog, later as a liquid on the walls of the cell. Progress of the reaction at various stages during irradiation was monitored by measuring the total pressure. Reaction products were analyzed by infrared spectroscopy, nuclear-magnetic-resonance and mass spectrometry. Among other things, this showed that molecules of CSCl_2 reacted in a one-to-one ratio with DEE.

The pressure data were used to calculate the quantum efficiency—the probability that a quantum of radiation would be absorbed by a target molecule and lead to the desired reaction. A quantum yield greater than 0.5 was found for the CSCl_2 -DEE reaction.

Molecules of $\text{CS}^{35}\text{Cl}_2$ were selectively excited by tuning the dye laser to a wavelength of 4705.5 angstroms. After about 4 hours of irradiation, the initial 75-percent concentration of chlorine-35 in the gas was reduced to 64 percent. Molecular transition energies for the various isotopic species of CSCl_2 differed by from 1 to 10 cm^{-1} and could easily be selectively excited by the laser radiation which has a linewidth of less than 0.3 cm^{-1} .

Excitation of $\text{CS}^{37}\text{Cl}_2$ was made possible by the accidental near coincidence between the 4657.84-angstrom emission of the Ar^+ laser and the 4657.89-angstrom absorption line of the $\text{C}^{32}\text{S}^{37}\text{Cl}_2$ form of thiophosgene. Irradiation by the Ar^+ laser, again for about 4 hours, reduced the concentration of chlorine-37 in the gas from 24.5 to 20 percent.

Details on the chlorine experiment are given in *Chemical Physics Letters*, 15 January 1975, pp. 165-170. A paper on the boron experiment will appear in the same journal. □



Dr. Joseph Ritter condenses reaction products from the boron experiment in cryogenic traps prior to analysis by infrared spectrophotometry and mass spectrometry.

NBS Tests EPOXIES to Protect Bridges

SINCE the mid-1960's, American taxpayers have been paying over \$70 million each year to repair highway bridges damaged largely by de-icing salts.

In an effort to reduce this loss, the Federal Highway Administration (FHWA) contracted with the National Bureau of Standards to test various inorganic coatings for the steel reinforcing bars used in these bridges. NBS found that certain epoxy coatings provide good protection.

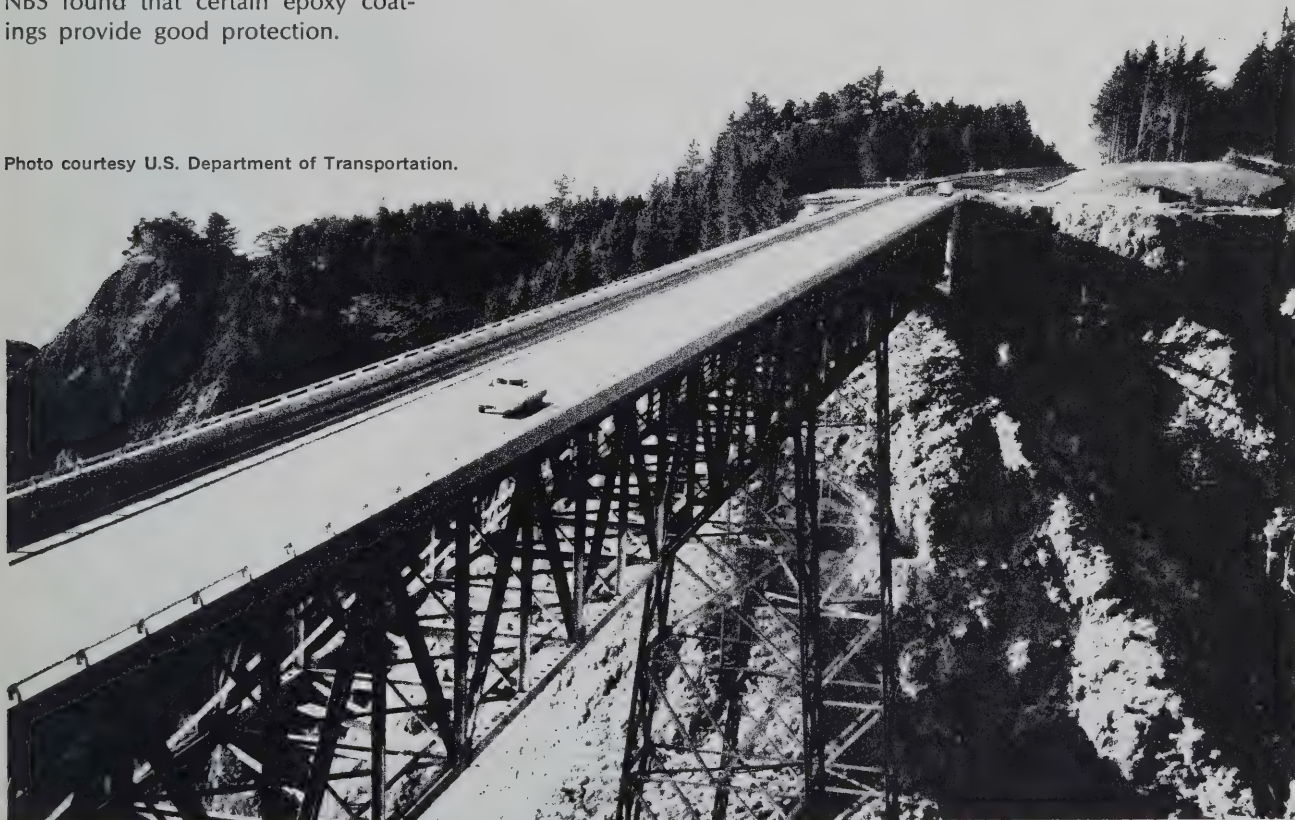
By protecting the steel from chloride ions in de-icing salts, seawater or other sources that penetrate the concrete bridge surface, these epoxy coatings can eliminate the corrosion that causes cracks in the concrete. The coatings should at least double the lifespan of reinforcing bars; corrosion of uncoated bars has seriously damaged bridges in as short a time as 5 years after construction.

After testing 47 different coatings, NBS scientists have observed that four powder epoxies adequately protect reinforcing bars. Presently they are developing performance criteria and specifications for new coatings that may be developed in the future.

FHWA contract manager Howard Arni said, "Epoxy coatings look very promising to us now—if you protect the steel from corrosion, a large part of the problem is solved."

One reason why the epoxy coating idea may prove a promising solution to this costly problem is that
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Photo courtesy U.S. Department of Transportation.



Har



MAN'S ETERNAL
DREAM MOVES
CLOSER TO
REALITY

Harnessing the SUN

ADVOCATES of solar power are fond of pointing out that, in principle, the entire present energy requirements of the United States could be provided by converting sunlight to other forms of energy—using an area equivalent to only 10 percent of the existing U.S. farmland. But harnessing even a fraction of the sunlight falling on the United States into usable forms of power is another matter entirely.

Utilizing the sun's radiation, which has far lower intensity at the earth's surface than heat in a conventional boiler, converting the energy to other forms of power, finding means of storing the energy so power is available at night and during cloudy spells, developing technology to use solar energy both to heat and cool build-

ings economically—these are only a few of the problems in transforming our most abundant, available and pollution-free energy resource into a major energy source.

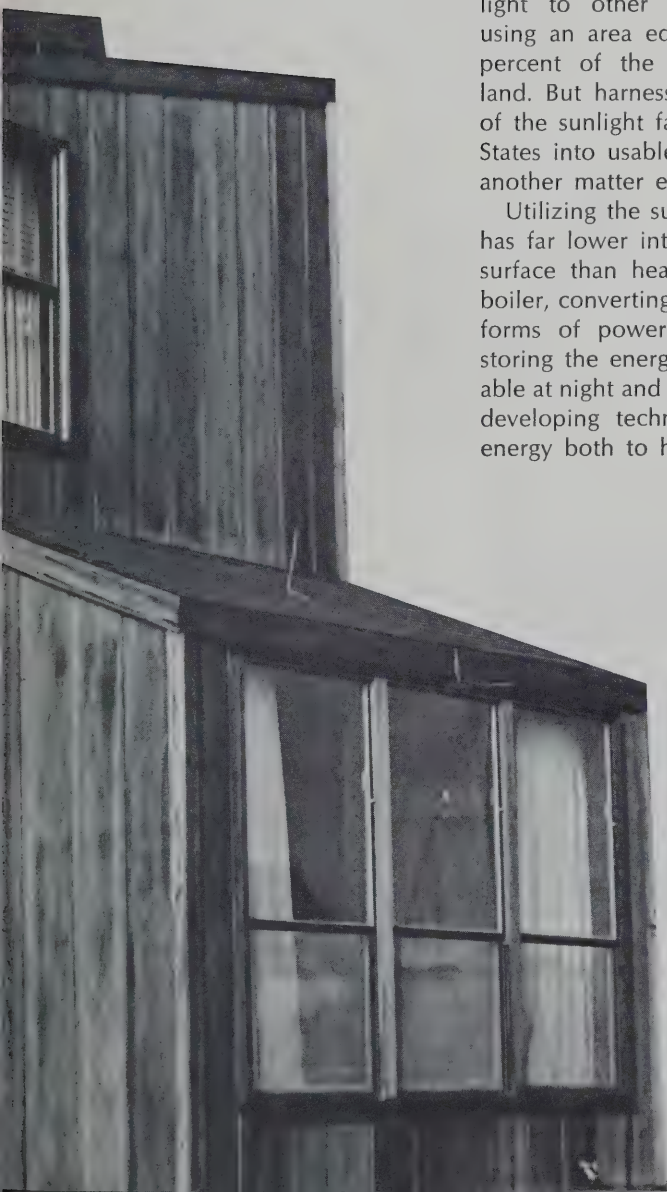
The National Bureau of Standards is currently tackling a number of the formidable obstacles to the practical use of solar power. Working for and with other Federal agencies, NBS researchers are:

- Developing performance criteria for solar systems to be installed in residential buildings under the Solar Heating and Cooling Demonstration Act of 1974.
- Testing a solar heating and cooling system on a four-bedroom townhouse to determine the feasibility of adding solar heating and cooling components to a house originally designed to operate with a conventional system.
- Evaluating a solar heating and cooling system in an office building in New Hampshire which will provide 45 to 50 percent of yearly fuel requirements for the heating and cooling equipment.
- Establishing testing methods for solar collectors and storage devices, the heart of any solar system.

Demonstration Act

There is an enormous potential for using solar energy to provide heating and cooling for individual buildings. On an average, two or more times as much energy from sunshine falls on the roof of a house as is required for

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SUN continued

round-the-clock heating or cooling. Yet in the 30 years prior to 1970 there were only a few dozen buildings built around the world designed to use solar energy for partially or totally heating the building. Today, many times that number of buildings are using or will soon use solar energy for heating and/or cooling.

Encouraging the widespread development and use of solar heating and cooling systems in residential and commercial buildings is the goal of the Solar Heating and Cooling Demonstration Act of 1974, for which the Energy Research and Development Administration has been given lead responsibility. This act gives the Department of Housing and Urban Development (HUD) the authority to install and evaluate solar systems in residences in various parts of the country. More than \$60 million has been authorized for the act through the end of the decade. Over two-thirds of these funds are earmarked for residential application of solar energy.

Since the act calls on NBS to

assist HUD in a variety of ways, a Solar Demonstration Program was established at the Bureau headed by Robert D. Dikkers. As the first step, an interdisciplinary team of a dozen NBS scientists, engineers and architects in NBS' Center for Building Technology developed interim performance criteria for the solar heating and combined solar heating and cooling systems which will be installed and evaluated by HUD in new residential buildings. HUD will use the criteria to select designs for the solar systems in an open competition. The criteria will also serve as guidelines for designers, manufacturers and evaluators of the systems.

The interim performance criteria also will provide a basis for the development of more definitive performance criteria at a later date, according to Dikkers. However, in order to incorporate feedback from the demonstration program, the interim criteria may be revised a number of times before final criteria are drawn up.

In addition to developing perform-

ance criteria, NBS will assist HUD in monitoring the performance of the systems, in developing test procedures to be used in certification of solar systems and in evaluating consumer acceptance of the systems.

Solar House

On a more individual basis, researchers in the Center for Building Technology are evaluating the contribution the sun can make toward providing heating, cooling and hot water for a four-bedroom townhouse on the NBS grounds in Gaithersburg, Md. These studies currently are funded by the Federal Energy Administration.

The thermal performance of the house, fitted with a gas-fired, forced air heating system and a central electrical air conditioning unit, already had been determined in an earlier research project sponsored by HUD. Recently, the townhouse was fitted with a 45-square-meter (485-square-foot) flat plate solar collector mounted on the roof and a thermal storage system consisting of water tanks with an aggregate capacity of 5.7 cubic meters (1500 gallons).

Energy to cool the house will be provided by an "absorption-refrigeration" unit. Essentially this unit operates on the same principle as a conventional gas air conditioner or refrigerator, with the solar-heated fluid replacing a gas flame as the primary heat source. The townhouse unit was modified to use hot water instead of natural gas as the source of energy for the generator section. This unit is one of about ten "water-fired" units under test in the United States, according to project leader Dr. James E. Hill. The others are

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Solar collector rack in final stage of construction on the NBS test house.



Installation of solar collectors.

HIGHLIGHTS

Air Pollution Measured

NBS chemists have developed a nitrogen dioxide permeation device intended primarily for calibrating air pollution monitoring apparatus. The device, now available as a Standard Reference Material, should also prove useful in the verification of air pollution analytical methods and procedures. Both NBS and the Environmental Protection Agency supported the development and evaluation of the device.

For information, write the Office of Standard Reference Materials, B311 Chemistry Building, NBS, Washington, D.C. 20234.

Home Playground Equipment

At the request of the National Association of Children's Home Playground Manufacturers, NBS has developed a recommended voluntary product standard aimed at minimizing injuries on home playground equipment such as swings, slides and jungle gyms.

The recommended standard is now being reviewed by producers, distributors, consumer groups and others having an interest in home playground equipment. Information on the standard can be obtained from John Tascher, B165 Technology Building, NBS, Washington, D.C. 20234.

Marine Pollution Monitoring

Recommendations for the initiation of a coordinated pilot project for marine pollution (petroleum) monitoring are included in the proceedings of the Marine Pollution Monitoring Symposium that were published recently by NBS, the Maritime Administration and the National Oceanic and Atmospheric Administration. Held

May 13-17, 1974, the symposium was also sponsored by the Intergovernmental Oceanographic Commission (IOC-UNESCO) and the World Meteorological Organization.

Titled "Marine Pollution Monitoring (Petroleum)," the publication is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, as stock number 0303-01359 for \$3.90.

Disk Calibration Service

NBS now provides calibration service for medium-density magnetic disk surfaces. NBS began calibrating low-density disks last summer, recently expanded its service to include medium-density disks and plans to begin calibrating high-density disks this fall.

This calibration service is performed in support of related U.S. and international standardization activities and is available to computer manufacturers in the United States and abroad. Disk surfaces are calibrated to the Primary Standard Amplitude and Data References maintained at NBS.

International MHD Conference

NBS will cosponsor the Sixth International Conference on Magneto-hydrodynamic Electrical Power Generation to be held at the U.S. Department of State, 2210 C Street, N.W., Washington, D.C., June 9-13, 1975. Three main topics will be featured: open cycle MHD systems, plasma closed cycle MHD systems and liquid-metal closed cycle MHD systems.

The conference is sponsored by NBS; the Energy Research and Development Administration; the Office of

Naval Research; the Electric Power Research Institute; and the Symposia for the Engineering Aspects of Magnetohydrodynamics, Inc., in cooperation with the International Atomic Energy Agency and the Nuclear Agency of the Organization for Economic Cooperation and Development.

Automated Acoustic Measurements

A novel instrument for automated, accurate and simultaneous measurement of acoustic emission and crack velocity parameters of ceramics has been developed at NBS. The measurement system is interfaced with a time-shared computer for rapid data analysis.

The data are being used to develop proof testing and destructive field monitoring procedures that will predict the lifetime of components and structures during service. Materials studied to date include silicon nitride for use in high temperature gas turbine engines, refractories for coal gasification reactors and porcelain for large electrical insulators.

Metric Conference

A major metric education conference, "Successful Experiences in Teaching Metric," will be held at NBS, Gaithersburg, Md., on May 20-21, 1975. The conference will be part of the United States' observance of the 100th anniversary of the Metric Convention, which inaugurated the international metric system.

At the conference, classroom teachers, administrators and teacher trainers will detail their successful experiences in introducing the metric system into their operations. Information is available from the Metric Information Office, NBS, Washington, D.C. 20234. □

Managing Information as a Resource

IT has been said that the United States is entering the third phase of the industrial revolution. If the first phase was dependence on management of raw materials, and the second, dependence on management of industry, then this phase will be increasingly concerned with the management of information.

The information explosion in this country has reached such unmanageable proportions that we would be hopelessly lost without the computer and its ability to store and speedily retrieve this information in the form of data.

However, unlike our control of other resources such as personnel and equipment, little thought has been given until recently to managing information as an essential resource. The work of developing standards and guidelines to help Federal agencies better manage and utilize their vast individual information resources falls to the ADP Standards program of the National Bureau of Standards.

The goal of this program is to improve computer utilization through the development of mandatory standards for Federal computers and voluntary standards for industry in cooperation with the American National Standards Institute.

Currently, 10 Federal Information Processing Task Groups, involving more than 200 participants from government and industry, are setting standards and guidelines in specific areas of computer usage and information management.

However, before an agency can manage information, it must first identify and describe the resource by defining the basic units of information

(data elements) contained in its automated and manual data bases. This description and identification take the form of a data element directory—a single authoritative “inventory” of the organization format, location and use of data elements. Data element directories are a way of monitoring and controlling information resources without having to integrate or centralize the data.

Several Federal agencies and departments have already established such directories and are utilizing automated techniques to build and manipulate them. FIPS Task Group 17 of the NBS Standards Program is working with representatives from 37 Federal departments and agencies in developing standards for constructing such directories. The task group, which held its initial session at NBS in February, plans to make these guidelines available by October 1975.

According to Harry S. White, Jr., Associate Director for the ADP Standards Program of the NBS Institute for Computer Sciences and

Technology, the task group will establish data directory standards and guidelines for use by Federal agencies in their information management functions. The guidelines developed by the group are also expected to be useful in providing adequate security measures for protecting sensitive data.

In light of recent Federal privacy legislation and the added emphasis being given to problems of data security and the valid use of information, the data element directory takes on even greater importance. Without a directory, an information manager does not know what information he has available or where it is located and, therefore, he has no means of monitoring and controlling his data resources.

Additionally, because the management of information involves the processes of data collection, transmission, processing and storage, control of these functions through the use of data directories is essential in providing adequate data security measures. □

Effects on Piezoelectric Accelerometers Determined

A simple, inexpensive method has been developed by researchers at the National Bureau of Standards for determining the effects of thermal transients on the zero output and sensitivity of piezoelectric accelerometers.

The method is reported in NBS Technical Note 855 coauthored by Carol F. Vezzetti and Paul S. Lederer

of the Electronic Technology Division in NBS' Institute for Applied Technology. They performed their work at the request of the Energy Research and Development Administration's Lawrence Livermore Laboratory.

Piezoelectric accelerometers are used extensively for measuring shock and vibrational motion in structures and components. These measure-

ments may be used to demonstrate the ability of structures to withstand acceleration environments without damage and to verify that components will operate with specified performance during and following exposure to shock or vibration conditions.

Accelerometers used for these measurements may also be subjected to thermal-transient stimuli while measuring shock and vibration caused by blasts. Examples of such blasts are explosions of various kinds including real or simulated atomic explosions. Certain properties of piezoelectric accelerometers can cause them to generate spurious output signals in response to such thermal transients, leading to significant measurement errors.

Limitations to an analytical predic-

tion of the effects of thermal transients on the performance characteristics of piezoelectric accelerometers demonstrate a need for an experimental method of assessing these effects.

In the NBS work, thermal transients were generated by an incandescent lamp and controlled by a mechanical shutter and were made to heat the top or side of the test accelerometer. Fourteen accelerometers utilizing a variety of construction techniques were tested using this method. Zero shifts with magnitudes as high as 640 g_n were observed. Zero shifts of up to 2 percent of full scale resulted from 1-second duration transients, and up to 7 percent of full scale from 15-second transients. The results were obtained at a radiation power density of 1.8

W/cm². No changes of accelerometer sensitivity exceeding experimental uncertainties were noted as a result of the thermal transients used.

Copies of Technical Note 855, "An Experimental Method for the Evaluation of Thermal-Transient Effects on Piezoelectric Accelerometers," may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Order prepaid (\$1.05) by SD Catalog No. C13.46:855. Foreign remittances must be U.S. exchange and include an additional 25 percent of the publication price to cover mailing costs. Order microfiche copies prepaid by NTIS No. COM-75-50121 from National Technical Information Center, Springfield, Va. 22151; the price is \$2.25 (domestic) or \$3.75 (foreign) a copy. □

NBS to Study Computers and Copyrights

PROBLEM: You have written and copyrighted a book. A major library enters the text of your book on its computerized information retrieval system. They do not pay you a royalty. Can you sue them under the copyright law?

The answer is yes, no and maybe, depending on the court's interpretation of the 66-year-old copyright law—a piece of legislation hardly designed for today's information technology and tomorrow's information explosion.

The computer-copyright contro-

versy will be the subject of an 18-month study to begin soon at the National Bureau of Standards. The NBS Institute for Computer Sciences and Technology (ICST) has received \$150,000 from the National Science Foundation to study the impact of computer law and economics on information technology.

The NBS study will investigate the impact of copyright law on user needs and access to computerized scientific and technical information. Its aim will be to identify and recommend legally, economically and tech-

nically sound alternatives which are beneficial to the public, the information industry and copyright owners. The study will also point out policy issues which are crucial to the continued availability of scientific and technical information.

For instance, many people have suggested establishing a central copyright clearing house for procurement of licenses and payment of royalties.

However, no previous studies have examined the technological and economic feasibility of a central clearing

turn page



house. Problems involved with the vast amounts of information and transactions, the high accounting costs, and the methods of royalty payment could affect the clearing house's feasibility.

Legal and policy problems will also be taken up by the NBS study. The central legal question, which remains unresolved, is whether or not magnetic tape used to store words in data banks constitutes a "copy" under the law.

Until recently, courts have usually upheld the precedent of a turn-of-the-century case involving player-piano music rolls. In this case, the court ruled that since the piano rolls were unintelligible to a human—that is, they could not be read or understood—copyright could not be upheld.

However, in a more recent case involving cable television, the court ruled that videotapes of television programs constituted copies under the law. This case of videotaped copy approaches the problem of magnetic tape in data banks.

During the time span of the NBS study, national attention will be increasingly focused on the computer-copyright controversy. A copyright bill signed into law by President Ford on December 31, 1974, calls for studies to be conducted concerning copyrights and computer systems.

The law also establishes a commission that will examine technological problems related to copyrighted works, such as photocopying. The NBS study will have implications for the work of that commission, as well as for people in government, industry, publishing and law. □

New Standards for Computer Codes and Controls

TWO new computer standards directed toward improving the use of automated systems by federal departments and agencies have been approved by Secretary of Commerce Frederick B. Dent.

The standards were developed by the Institute for Computer Sciences and Technology of the National Bureau of Standards in cooperation with the American National Standards Institute (ANSI). The standards will be used in the acquisition of all new federal computer systems beginning on June 1, 1976.

The first standard, "Code Extension Techniques in 7 or 8 Bits," provides uniform methods for extending the 7-bit coded character set of ASCII (the American Standard Code for Information Interchange). This extension allows additional characters and control codes to be added to the existing alphabet used in computer and telecommunications equipment and applications.

The new standard, which will be published by NBS as Federal Information Processing Standard (FIPS) 35, has been adopted as a voluntary national standard by ANSI and the International Organization for Standardization.

This standard allows the extension of computer alphabets so that other language symbols can be processed and interchanged. It is expected, therefore, that it will provide for the first time a technical capability for the

world-wide interchange of data. Associated standards are now under development for the Greek, Cyrillic and African alphabets. Also, additional Roman and mathematical symbols are to be provided.

The second standard, "Graphic Representations of the Control Characters of ASCII," provides standard symbols (both pictorial and alphanumeric) for the control codes used in computer and communications operations. In the past, no common method for displaying or writing these codes existed.

This standard, to be published by NBS as FIPS 36, has been adopted by industry as American National Standard X3.32 and as International Standard 2047.2.

In 1974, an NBS assessment of the impact and significance of ASCII as a federal standard found that additional associated standards for ASCII were needed before its use could be fully effective. These two new standards are among those cited in the recommendation. None of the existing computer codes provide the flexibility and increased capabilities of ASCII as extended by these two new standards.

FIPS 35 and 36 should be available from the Government Printing Office in June 1975. Advanced typed copies can be obtained from the NBS Office of ADP Standards Management, Institute for Computer Sciences and Technology, NBS, Washington, D.C. 20234. □

Revised Bill for Voluntary Metric Conversion Submitted to Congress

THE Department of Commerce has resubmitted to the Congress a revised administration bill to chart a course for the voluntary conversion to the metric system in the United States.

"This bill proposes a sound, rational approach to metric conversion," stated Acting Secretary of Commerce John K. Tabor. "It will place the United States back in the mainstream of industrialized nations that have committed themselves to metric," he added.

The bill, known as the Metric Conversion Act of 1975, calls for the creation of a 25-member United States Metric Board to plan and coordinate a voluntary changeover. The Board would submit yearly reports to the President and the Congress stating progress achieved towards metrification. The Board would be dissolved when Congress determined its mission had been accomplished.

The bill is similar to one introduced into the 93rd Congress which was not acted upon. It has been changed in some parts to meet objections brought out at the hearings. The principal change is the elimination of a comprehensive 10-year plan that would have been developed by the Board. The changeover will instead take place over a period of time to be determined by all economic sectors as coordinated by the Board.

Secretary Tabor noted that the United States is the only industrially developed nation which has not established a policy committing itself to the metric system of weights and measures. Under this bill, the Nation would be "predominately, although not exclusively, metric," Tabor said.

Twenty-one members of a U.S. Metric Board would be appointed by the President and would broadly represent American society including industry, labor, business and commerce, the consumer, education, State and local government, science and engineering. The remaining four members would be selected from the Congress—two members of the House of Representatives, from different political parties, appointed by the Speaker of the House and two members of the Senate, also of different political parties, appointed by the President of the Senate.

Under the provisions of the bill, the Board would:

- Consult with and take into account the interests, views and conversion costs of the United States' commerce and industry, including small business; science; engineering; labor; education; consumers, Federal, State and local government agencies; standards developing organizations; metric conversion planning and coordinating groups; and other interested individuals or groups.

- Provide appropriate procedures whereby various groups under the Board's auspices can formulate and recommend to the Board, specific programs for coordinating conversion in each industry and for suggesting specific metric sizes, shapes and other measurements for general use.

- Publicize proposed programs and provide an opportunity for interested groups or individuals to submit comments on such programs.

- Encourage the retention in new metric language standards of those U.S. engineering designs, practices and conventions that are interna-

tionally acceptable or embody superior technology.

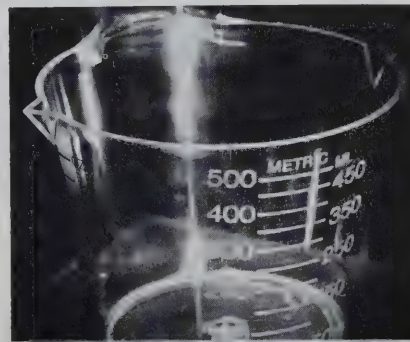
- Assist the public, through information and education programs, to become familiar with the meaning and applicability of metric terms and measures in daily life.

- Collect, analyze and publish information about the extent of usage of metric measurements; evaluate the costs and benefits of metric usage, and make efforts to minimize any adverse effects resulting from increasing metric usage.

The Board will submit proposed conversion programs to the President, who will approve or disapprove them within 60 days. Upon approval, the President will forward the proposals to Congress, and the programs will be implemented 60 legislative days after their receipt by the Congress. Any program disapproved by either the President or the Congress will be revised and resubmitted by the Board within 60 days.

An executive director of the Board will be appointed by the President, according to the DoC bill. He will be responsible for carrying out the metric conversion program according to the provisions of the Act and the policies established by the Board.

The bill calls for the authorization of "such sums as may be necessary" to carry out the provisions of the Act. □



Natural Hazard Evaluation of Existing Buildings

BUILDING failures in the wake of earthquakes, hurricanes and tornadoes each year exact a tragic death toll and property damages averaging at least \$1 billion.

Taking what is described as "a first step" toward a building technology capable of substantially reducing these losses, the Center for Building Technology at the National Bureau of Standards has just published a 964-page study on *Natural Hazard Evaluation of Existing Buildings*.

The study, sponsored by the Defense Department's Defense Civil Preparedness Agency (DCPA) under the 3-year-old Cooperative Federal Program of Building Practices for Disaster Mitigation, develops criteria applicable to general community safe-construction planning as well as to the DCPA's shelter program.

The study was prepared by Dr. Charles G. Culver and Dr. H. S. Lew of NBS in collaboration with Gary C. Hart of the J. H. Wiggins Co. and Clarkson W. Pinkham of S. B. Barnes and Associates.

Natural Hazard Evaluation of Existing Buildings proceeds on the principle that all substantial risks should be considered in the design, construction and use of a building. The authors consulted widely with other experts, including DCPA officials and specialists at the University of Michigan, the Metropolitan Dade County (Fla.) Building and Zoning Department, the Portland Cement Association, the Wisconsin State Department of Industry, Labor and Human Relations, California structural engineers and Dr. Richard N. Wright, formerly of the University of Illinois, the present director of the NBS Center for Building Technology.

Natural Hazard Evaluation of Existing Buildings presents a methodology for surveying typical buildings to determine the risk to life and safety under natural hazard conditions and estimate the amount of expected damage. Earthquake, hurricane and tornado damage to both structural and nonstructural building components is considered.

The book's methodology is applicable to a large class of structural types including braced and unbraced steel frames, concrete frames with and without shear walls, bearing wall structures and long-span roof structures.

Three independent but related sets of procedures for estimating damage for each of the natural hazards are described. The first set of procedures provides a means for qualitatively determining the damage level on the basis of data collected in field surveys of the buildings. The second set estimates damage levels as a function of behavior of critical elements, coupled with a structural analysis of the buildings. The third set reflects a computer analysis of the entire structure. All three sets of procedures are based on the current state-of-the-art.

NBS plans to periodically update the study, recognizing that disaster mitigation research is a key area now in a stage of rapid development.

Natural Hazard Evaluation of Existing Buildings, No. 61 in the NBS Building Science Series, may be ordered at \$11.10 a copy from the Superintendent of Documents, Washington, D.C. 20402. Order prepaid by SD Catalog No. C13.29/2/61. □



This light-gage steel roof, demolished by a tornado, typifies situations analyzed in Natural Hazard Evaluation of Existing Buildings.

being used in residential solar cooling experiments in such places as Colorado State University, the National Aeronautics and Space Administration's Marshall Space Flight Center, the Honeywell Corporation in Minneapolis, Minn., Ohio State University, and in Tucson, Ariz.

"This is one of the first studies in which the same building will have been tested with both a completely conventional as well as an integrated solar system," says Hill. "The solar system is designed to supply three-quarters of the energy needs of the house."

Hill, NBS engineer Tom Richtmyer and technicians Jim Allen and Don Ebberts will test the house and solar system for selected periods while the weekly living pattern for a family of six is simulated. The simulation is accomplished by heat sources placed throughout the house in addition to having all major appliances and bath facilities operated on a regular, prescribed schedule. Tests are scheduled to begin this summer and continue for selected periods during the fall, winter and early spring. Finally, in the summer of 1976 the same tests will be performed with a modified solar collector and the results will be compared with this summer's results.

In addition to the energy consumption comparison with and without the solar system, the project will furnish state-of-the-art data and contribute to evaluation procedures for total solar systems, Hill says.

Office Building

Solar energy can also potentially provide a large proportion of the energy needs of commercial buildings. In this area, NBS scientists under

the direction of Dr. Tamami Kusuda are cooperating with the General Services Administration in the application of a solar system to a government office building being built in Manchester, New Hampshire. The \$9.5 million office building, slated for occupancy in July 1976, will have a 427-square-meter (4600-square-foot) solar collector on the roof of the seven-story building. The collector is designed to supply heating, cooling and hot water to the top four floors of the buildings, or about 45 to 50 percent of the total fuel requirement for the building. After the building is occupied, NBS will be evaluating the performance of the solar system.

Key to all solar systems for residences and commercial buildings are collectors and thermal storage units. Several different types of each device have been developed by researchers and industrial firms throughout the country, Hill points out. However, different methods and procedures have been used to test and report the performance of these devices and it has been difficult sometimes to compare components, even when they are of the same general type.

Seeking a basis for comparing units, Hill, Kusuda and Dr. George Kelly have developed proposed standard

test methods for rating the thermal performance of both solar collectors and thermal storage units. These proposed standards, developed under the sponsorship of the National Science Foundation, have been submitted to the American Society of Heating, Refrigerating and Air Conditioning Engineers for approval as ASHRAE Standards.

Energy Alternative

For a long time, solar power has been used only by a few people in Florida, Southern California and several foreign countries who were willing to experiment with solar power to heat their homes and domestic hot water. Today, scientists in government, universities and private industry are trying to move solar power into the realm of reality. In addition to the areas under study at NBS, scientists are investigating the use of solar "farms" to generate electrical power on a large scale, solar cells for converting sunlight directly into electricity, and biological conversion of sunlight to various energy forms. In a world with limited resources and an expanding demand for power, solar power now appears to be a promising energy alternative to fossil fuels. □



Another room was added to the four-bedroom townhouse to hold storage tanks and associated equipment.

NETWORKS *continued*

commands. The Network Access Machine can connect to different systems, translate between different languages and significantly facilitate the delivery of network services to customer.

Along with the satisfaction of making networks easier to use, comes the added responsibility of ensuring that they are used in a proper and responsible manner. One special aspect of maintaining data confidentiality in a networking environment is the need to identify the user of a particular terminal in order to limit the data which may be accessed. What is needed is a simple and inexpensive means of personal identification which can be connected or built into terminals. NBS is examining available personal identification technology and experimenting with the integration of this technology with terminals and communications facilities.

Computer networks have emerged as a powerful national force touching every individual in society. NBS is helping to assure that networks are exploited to their fullest potential and that confidential data within networks is well protected. □



Networks play an important role in traffic control as well as many other services provided to the public.

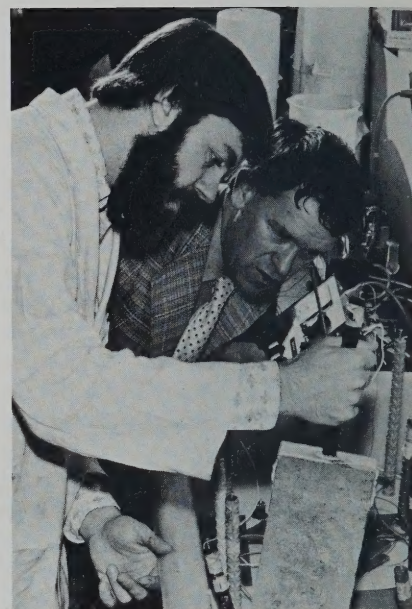
EPOXIES *continued*

it is economically feasible. Although a bridge constructed with coated reinforcing bars would cost more than one without coated bars, the finished bridge would require no further attention as far as problems connected with corrosion of the steel are concerned. Some other alternatives require periodic maintenance which adds to their costs. For this reason, many engineers think epoxy coatings provide an economically viable alternative.

NBS research chemist Dr. James Clifton and his associates tested a variety of coatings for impermeability to chlorides, durability, bonding to concrete, bending without cracking and staying in place under stress. In one test, epoxy-coated bars were embedded in concrete blocks and placed in a tub of salt water for 2 years. Even after 2 years, they showed no signs of corrosion.

Epoxies consists of two components—a resin component and a curing component—that “polymerize” when mixed together. Polymerization is a type of chemical reaction which forms long chain molecules; the reaction changes the nature and appearance of the substance. Polymers have been used widely in science, industry and even art in recent years.

Clifton found powder epoxies, which polymerize at about 200 degrees Celsius, preferable to liquid epoxies, which begin to “cure” at room temperature after the two components are mixed. Powder epoxies do not require mixing, and they can coat steel more evenly than liquids.



Erik Anderson and Dr. James Clifton inspect the epoxy coatings on steel reinforcing bars that were embedded in concrete and soaked in salty water for 2 years.

Clifton also found that the best way to apply the powders is with an electrostatic spray gun. This type of sprayer creates an electric charge between itself and the hot steel bar. Powder particles pick up the charge and are attracted to the bar, where they melt and begin to cure instantly. This spraying method is fast and provides a very even coating.

In addition to their use in bridges, epoxy-coated bars could be used in parking garages, concrete structures in saltwater environments, offshore drilling facilities, and possibly in nuclear reactors. □

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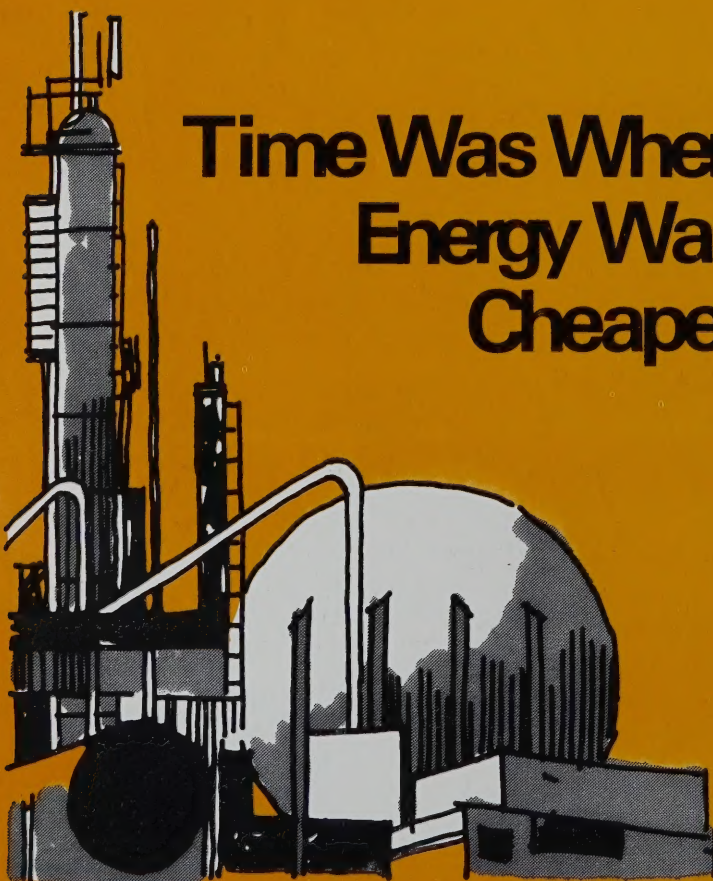
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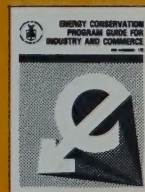
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